(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 939 417 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.09.1999 Bulletin 1999/35

(51) Int. Cl.[6]: **H01H 85/041**, H01H 69/02

(21) Application number: 98830097.6

(22) Date of filing: 25.02.1998

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

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(54) A blade fuse

(57) A blade fuse comprises an envelope (2) of electrically-insulating material and a metal element (3) housed in the envelope (2). The metal element (3) is formed in a single piece and comprises two spaced-apart, blade-like electrical terminals having lower ends projecting from the envelope (2), and a fuse element which connects the heads of the blade-like electrical terminals and extends transversely relative thereto. The thickness of the fuse element is less than that of the blade-like electrical terminals so that the fuse element has a cross-section calibrated in dependence on the nominal current provided for.

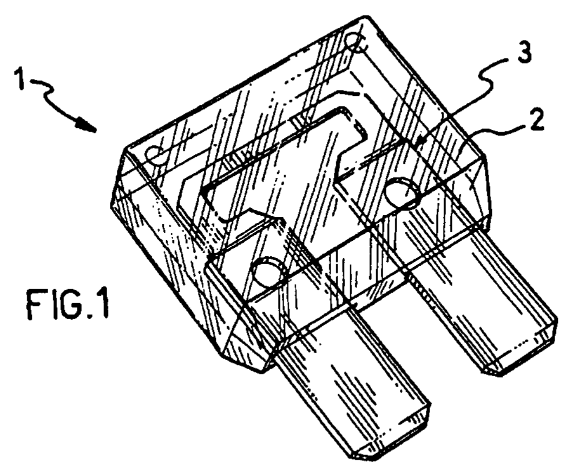

FIG.1

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Description

[0001] Th present invention relates to a blade fuse of the type normally used, for example, in the automotive field for ensuring that electrical systems are adequately protected against short circuits.

[0002] More particularly, the invention relates to a blade fuse comprising an envelope of electrically-insulating material and a metal element housed in the envelope, the metal element comprising two spaced-apart, blade-like electrical terminals having respective head ends and electrically connected by a fuse element which is intended to melt when a predetermined nominal current is exceeded, the blade-like electrical terminals and the fuse element being formed in a single piece from a metal band, and the thickness of the fuse element being less than the thickness of the blade-like electrical terminals so that the fuse element has a cross-section calibrated in dependence on the nominal current provided for.

[0003] The present invention also relates to a method of producing a blade fuse.

[0004] As is known, in fuses of the above-mentioned type, the fuse element which provides the electrical connection between the two electrical terminals has a cross-section calibrated in dependence on the nominal current (In) provided for by the fuse. This means that the flow of currents of greater magnitude than the nominal current causes the fuse element to heat rapidly until it melts so as to break the electrical continuity between the two blade-like electrical terminals.

[0005] In this connection, it should be pointed out that, in order for the fuse to operate quickly and effectively, its fuse element must have a sufficiently long portion with a calibrated cross section, the length of this portion being inversely related to the nominal current value of the fuse. In other words, for fuses having a lower nominal current intensity, the portion of the fuse element having a calibrated cross-section has to be longer.

[0006] The effectiveness of the protection which blade fuses provide for electrical systems, their reliability over time and, in particular, the ease with which they can be replaced after a short circuit has occurred, means that their use has increasingly met with approval to an extent such that there is currently a very high demand for these fuses.

[0007] Owing to the large quantities of these fuses required and to the fact that the commercial value of each fuse is very low, these fuses are mass-produced on an industrial scale.

[0008] It is clear from the foregoing that there is a need to restrict the production costs of these fuses or, in other words, to provide a fuse which, as well as being reliable and effective in the event of a short circuit, has characteristics such that it can be massproduced by a small number of simple operations and at as low a cost as possible.

[0009] One type of blade fuse currently on th market is produced by the welding of the fuse element to the ends of the two electrical terminals.

[0010] However, although these fuses are satisfactory from the point of view of their operation, that is, of the protection provided for the electrical systems in the event of a short circuit, they cannot satisfy the above-mentioned need.

[0011] In fact, since the thickness of the fuse element is of the order of tenths of a millimetre and the elements to be welded are generally made of zinc or tinned zinc, that is, of a material which is difficult to weld, this welding is clearly difficult to achieve correctly. Moreover, the production of the fuse requires the use of sophisticated welding machines which can control the welding parameters very precisely. Naturally, all of this leads to an increase in the production costs of the fuses.

[0012] Blade fuses in which the fuse element and the electrical terminals are formed in a single piece are also known. In these fuses, the cross-section of the fuse element is calibrated in dependence on the nominal current provided for by a suitable selection of the width of the fuse element and, in particular, by a reduction in the thickness of the fuse element in comparison with the thickness of the blade-like electrical terminals.

[0013] To achieve this, the fuses are formed by blanking from a metal band having a strip of reduced thickness which extends centrally along its axis and from which the fuse element is formed. Upon completion of the blanking, the fuse element extends between two blade-like electrical terminals formed from respective longitudinal portions of the parts of the metal band in which the thickness is not reduced.

[0014] However, since the dimensions of the fuse cannot be varied because they are standardized and the distance between the blade terminals is less than the minimum length necessary for the portion of the fuse element with the calibrated cross-section, in these fuses, it is necessary to blank the fuse element in a manner such as to make it S-shaped or Ω-shaped or to give it another curved shape. This produces a portion with a calibrated cross-section which is longer than the distance between the blade terminals.

[0015] Clearly, however, the successful blanking of the thinner strip of the metal band along a curved line of restricted height is a difficult operation the execution of which requires the use of precision blanking machines. This inevitably involves an increase in the production costs of the fuses.

[0016] In this context, it should be pointed out that, for blade fuses of this type, the most difficult production conditions arise for those having a nominal current of a few amperes, in which the portion with a calibrated cross-section to be cut along a curved line has a width and a thickness of one or two tenths of a millimetre.

[0017] The problem upon which the present invention is based is that of designing a blade fuse which has structural and functional characteristics such as to satisfy the aforementioned requirements and at the same

time to prevent the problems of fuses of the prior art.

[0018] This problem is solved by a blade fuse comprising an envelope of electrically-insulating material and a metal element housed in the envelope, the metal element comprising two spaced-apart, blade-like electrical terminals having respective head ends and electrically connected by a fuse element which is intended to melt when a predetermined nominal current is exceeded, the blade-like electrical terminals and the fuse element being formed in a single piece from a metal band, and the thickness of the fuse element being less than the thickness of the blade-like electrical terminals so that the fuse element has a cross-section calibrated in dependence on the nominal current provided for, characterized in that the blade-like electrical terminals are connected by the fuse element at their heads.

[0019] A method of producing the metal element of a blade fuse, the metal element comprising two spaced-apart, blade-like electrical terminals having respective head ends electrically connected to one another by a fuse element which is intended to melt when a predetermined nominal current is exceeded, comprises the step of providing a metal band comprising a portion of reduced thickness extending along a major longitudinal axis, and is characterized in that it comprises a blanking step to produce the metal element from the metal band in a single piece, the fuse element being formed by the strip of reduced thickness and the two electrical terminals being formed transversely relative to the longitudinal axis of the metal band, starting from the strip.

[0020] Further characteristics and the advantages of the blade fuse according to the invention will become clear from the following description of a preferred embodiment thereof, given by way of non-limiting example, with reference to the appended drawings, in which:

Figure 1 is a perspective view of a blade fuse according to the invention,
Figure 2 shows a part of the blade fuse of Figure 1,
Figure 3 is a perspective view of the metal band from which the part of Figure 2 is formed, and
Figure 4 shows the part of Figure 2 in an intermediate stage of its production.

[0021] With reference to the appended Figures 1 and 2, a blade fuse according to the invention is generally indicated 1.

[0022] The blade fuse 1 comprises an envelope 2 of electrically-insulating material, preferably a transparent plastics material such as, for example, polycarbonate or polysulphone, and a metal element or core 3 housed in the envelope.

[0023] The envelope 2 is preferably formed by two half-shells joined together.

[0024] The m tal element 3 may be made of zinc, tinned zinc or of another metal normally used for forming blade fuses.

[0025] The metal element 3 comprises two blade-like electrical terminals, each indicated 4 in the drawings, which are coplanar and extend parallel to one another in the direction of a major axis Y-Y.

[0026] The electrical terminals 4 have a thickness B and a width L and are spaced apart by a predetermined distance D. In the embodiment considered herein of a fuse having a nominal current (In) of 1A, the width L is a little more than 5 mm and the distance D is about 4 mm. As explained in the introductory portion of the description, these values, like the other dimensions of the fuse, are standardized.

[0027] The metal element 3 is housed in the envelope 2 in a manner such that the lower ends 5 of the electrical terminals 4 project from the envelope 2.

[0028] The two electrical terminals 4 are connected to one another electrically by a fuse element 7 which, as a result of theflow of currents of a magnitude greater than a predetermined nominal current, heats rapidly until it melts, breaking the electrical continuity between the two electrical terminals 4.

[0029] To achieve this effect, the cross-section of the fuse element 7 is calibrated, in dependence on the nominal current provided for, by a suitable selection of its width H and of its thickness S. In this connection, it is pointed out that the thickness S of the fuse element 7 is less than the thickness B of the electrical terminals 4 and the width H of the fuse element is less than the width L of the electrical terminals 4.

[0030] Purely by way of example, in the case of the fuse considered herein, which has a nominal current of the order of 1A, the thickness S is about 0.1 mm, and the height H is about 0.2 mm.

[0031] The fuse element 7 of reduced thickness S is connected to the head ends 6 of the electrical terminals 4 which have the full thickness B in a gradual manner with a predetermined connecting radius R so as to avoid the formation of a stepped connection.

[0032] The fuse element 7 is formed in a single piece with the two electrical terminals 4 and, advantageously, extends from the head end 6 of one of the two electrical terminals 4 to the head end of the other. The fuse element 7 forms a bridge connecting the head ends 6 of the electrical terminals 4 so as to extend in a direction substantially transverse the axes Y-Y of the electrical terminals 4.

[0033] As shown clearly in Figure 2, the fuse element 7 extends from the head end 6 of each electrical terminal 4, from the outer side of the electrical terminal, that is, it extends from the sides of the electrical terminals 4 which do not face one another. Since the width H of the fuse element 7 is less than the width L of the electrical terminals 4, it is possible for the fuse element 7 with a calibrated cross-section to have a length greater than the distance D between the electrical terminals 4 without having to be S-shaped or to have another curved profile.

[0034] The length of the fuse element 7 with a calibrated cross-section is in fact approximately equal to

the interaxial spacing of the electrical terminals 4 (D+2×L/2).

[0035] Since, in general, the width H of the fuse element 7 is less than half of the width L of the electrical terminals 4 and the width L of the electrical terminals 4 is approximately equal to the distance D between them, the length of the fuse element 7 with a calibrated cross-section is at least twice the distance D.

[0036] It is worth pointing out that the aforementioned solution of connecting the head ends 6 of the electrical terminals 4 to the fuse element 7 so as to form a connecting bridge is particularly advantageous for fuses having nominal currents of the order of a few amperes, that is, no greater than 10A, for which the production and operating conditions of the fuses of the prior art are most difficult.

[0037] However, even for blade fuses having nominal currents of the order of 30A or 40A, which have larger calibrated cross-sections and hence greater widths H, the aforementioned solution can achieve a sufficiently long portion with a calibrated cross-section without the need to shape it with a curved profile.

[0038] The electrical terminals 4 have holes 8 for engagement by corresponding pins (not shown in the drawing) of the envelope 2. The coupling between the pins of the envelope and the holes 8 of the electrical terminals 4 ensures correct positioning of the metal element 3 in the envelope 2 and at the same time ensures interlocking of the metal element 3 and the envelope 2.

[0039] The metal element 3 of the fuse 1 can advantageously be produced by simple blanking operations from a metal band or a metal sheet, and the reduction in the thickness of the fuse element can easily be achieved by milling.

[0040] It should be stressed that the structure of the fuse 1 according to the invention and, in particular, of its metal element 3 prevents the problems encountered in the production of blade fuses of the prior art, particularly in the production of blade fuses for nominal currents of the order of a few amperes.

[0041] A method of producing the metal element 3 of the blade fuse 1 according to the invention from a metal band 9 of predetermined axis X-X, width A and thickness B is described below with reference also to Figures 3 and 4. The thickness B of the metal band 9 is equal to that required for the electrical terminals 4 of the metal element 3 to be produced.

[0042] The band 9 is preferably made of zinc, tinned zinc or another metal normally used to produce blade fuses.

[0043] The metal band 9 has a strip 10 of reduced thickness. The strip 10 extends parallel to the axis X-X along a longitudinal side of the metal band 9.

[0044] The strip 10 of reduced thickness is preferably produced by milling or another type of processing to remove material. The thickness of the strip 10 is equal to the thickness S required for the fuse element 7 of the metal element 3 to b produced.

[0045] Naturally, the thickness S of the strip 10, or rather the reduction in the thickness of the metal band 9 to be achieved by milling, depends upon the nominal current value of the metal element 7 to be produced.

[0046] The strip 10 of reduced thickness S is connected to the remaining portion of the metal band 9 which has the full thickness B in a gradual manner along a predetermined connecting radius R so as to avoid the formation of a stepped connection.

[0047] The strip 10 is preferably spaced by a predetermined distance from the longitudinal side of the metal band 9 so that a rim 11 of thickness B is defined between the strip 10 and the longitudinal side.

[0048] To produce the metal element 3 of the fuse 1, the band 10 is blanked so as to form the fuse element 7 from the strip 10 of reduced thickness and the two electrical terminals from the portion of the metal band 9 having the full thickness B.

[0049] More precisely, the blanking is carried out in a manner such as to form the two electrical terminals 4 transversely relative to the axis X-X of the metal band 9, the fuse element 7 being formed by a longitudinal portion, that is, a portion extending parallel to the axis X-X, of the strip 10.

[0050] The holes 8 are formed in the electrical terminals 4 during the blanking.

[0051] The blanking step preferably comprises a first blanking step by which a blank 12 is separated from the metal band 9 (Figure 4) and a second blanking step in which the metal element 3 is formed from the blank 12.

[0052] The blank 12 comprises the two electrical terminals 4 the heads of which are connected to a portion 13 of the thinner strip 10. The corresponding portion of the rim 11 is still fixed to the portion 13. The two electrical terminals 4 of the blank 12 are also connected by a further portion 14.

[0053] After the first blanking step, the blank 12 is positioned in a support pallet, not shown in the drawings, and only subsequently, is subjected to the second blanking step.

[0054] During the second blanking step, the further connecting portion 14 between the two electrical terminals 4 is removed and the fuse element 7 is formed from the portion 13.

[0055] The presence of the rim portion 11 provides the blank 12 with greater stiffness and prevents the thinner portion 13 from being damaged before the blank 12 has been placed in the pallet.

[0056] The blade fuse 1 is produced by the insertion of the metal element 3 in the envelope 2.

[0057] The method described above enables the metal element of the blade fuse to be produced by simple blanking operations without encountering the problems of the prior art in the production of blade fuses by blanking. In fact, in the method of forming the metal el -ment according to the invention, it is not necessary to blank the thinner strip of the metal band along a curved line of restricted height. As a result, th production cost

of the metal element, and hence of the blade fuse 1, is less than that of the fuses of the prior art.

[0058] As can be appreciated from the description, the blade fuse according to the present invention has structural and functional characteristics such as to satisfy the aforementioned requirements and at the same time to solve the problems of fuses of the prior art, particularly the problems connected with the production of the fuses.

[0059] In fact, the structure of the blade fuse according to the present invention enables a sufficiently long portion with a calibrated cross-section to be produced without the need for it to be shaped with a curved profile, even for fuses having nominal currents of a few amperes.

[0060] Naturally, in order to satisfy contingent and specific requirements, an expert in the art may apply to the above-described method of production many modifications and variations all of which, however, are included within the scope of protection of the invention as defined by the following claims.

[0061] Thus, for example, as an alternative to the method described, the reduction in the thickness of the strip 10 of the metal band 9 may be achieved by rolling, by coining, or by another equivalent method.

[0062] The metal element of the fuse may be produced by blanking from a metal sheet instead of a band.

[0063] The lower ends of the electrical terminals may be female instead of male.

Claims

1. A blade fuse comprising an envelope (2) of electrically-insulating material and a metal element (3) housed in the envelope (2), the metal element (3) comprising two spaced-apart, blade-like electrical terminals (4) having respective head ends (6) and electrically connected by a fuse element (7) which is intended to melt when a predetermined nominal current is exceeded, the blade-like electrical terminals (4) and the fuse element (7) being formed in a single piece from a metal band (9), and the thickness (S) of the fuse element (7) being less than the thickness (B) of the blade-like electrical terminals (4) so that the fuse element (7) has a cross-section calibrated in dependence on the nominal current provided for, characterized in that the blade-like electrical terminals (4) are connected by the fuse element (7) at their heads.

2. A blade fuse according to Claim 1, in which the fuse element (7) extends like a bridge between the head ends (6) for a distance greater than the distance (D) between the blade-like electrical terminals (4).

3. A blade fuse according to Claim 1, in which the fus element (7) extends in a transverse direction relative to the blade-like electrical terminals (4).

4. A blade fuse according to Claim 1, in which the fuse element (7) of reduced thickness (S) is connected to the head ends (6) of the blade-like electrical terminals (4) in a gradual manner.

5. A blade fuse according to Claim 1, in which the thickness (S) of the fuse element (7) is reduced by the removal of material.

6. A blade fuse according to Claim 1, in which the envelope is formed by two half-shells.

7. A method of producing the metal element (3) of a blade fuse (1), the metal element comprising two spaced-apart, blade-like electrical terminals (4) having respective head ends (6) electrically connected to one another by a fuse element (7) which is intended to melt when a predetermined nominal current is exceeded, comprising the step of providing a metal band (9) comprising a strip (10) of reduced thickness (S) extending along a major longitudinal axis (X-X), characterized in that it comprises a blanking step to produce the metal element (3) from the metal band (9) in a single piece, the fuse element (7) being formed by the strip (10) of reduced thickness and the two electrical terminals being formed transversely relative to the longitudinal axis (X-X) of the metal band (9), starting from the strip (10).

8. A method according to Claim 7, in which the strip (10) of reduced thickness is formed by the removal of material.

9. A method according to Claim 8, in which the strip (10) of reduced thickness is formed by milling.

10. A method according to Claim 7, in which the strip (10) of reduced thickness is formed by rolling.

11. A method according to Claim 7, in which the strip (10) of reduced thickness is formed by coining.

12. A method according to Claim 7, in which the strip (10) of reduced thickness is connected in a gradual manner to the portion of the metal band (9) having the full thickness (B).

13. A method according to Claim 7, in which the strip (10) of reduced thickness is spaced from a longitudinal side of the metal band (9) by a predetermined limited distance, a rim (11) being defined between the strip (10) of reduced thickness and the longitudinal side.

14. A method according to Claim 7, in which th step of the blanking of the metal band (9) comprises:

- a first blanking step to separate from the metal band (9) a blank (12) comprising the blade-like electrical terminals (4) the heads of which are connected by a portion (13) of the strip (10) of reduced thickness and by further portions (14), and
- after the blank (12) has been positioned in a support pallet, a second blanking step to produce the metal element (3) from the blank (12) by eliminating the further portions (14) of the metal band (9) and trimming the profile of the fuse element (7) and of the blade terminals (4).

15. A method according to Claims 13 and 14, in which the rim (11) is removed during the second blanking step.

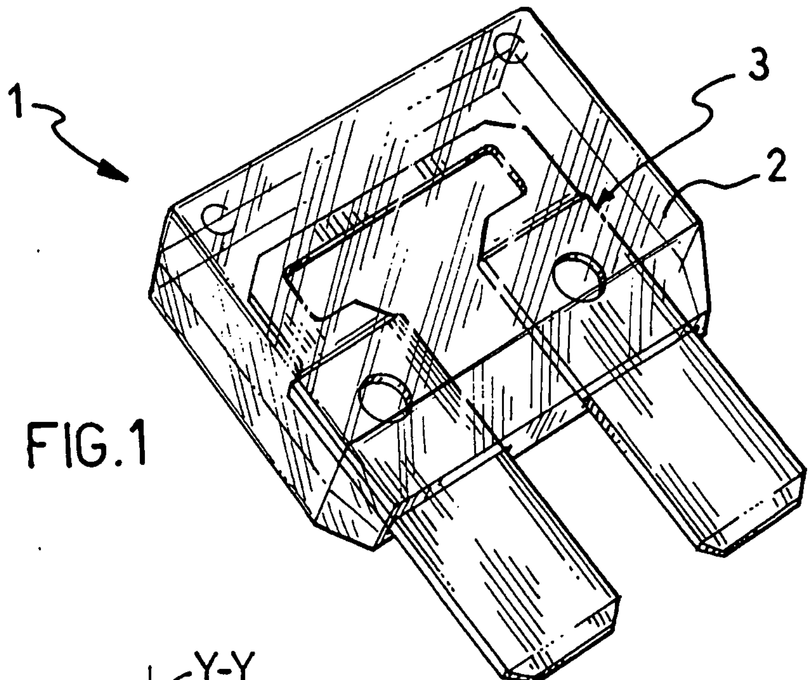

FIG.1

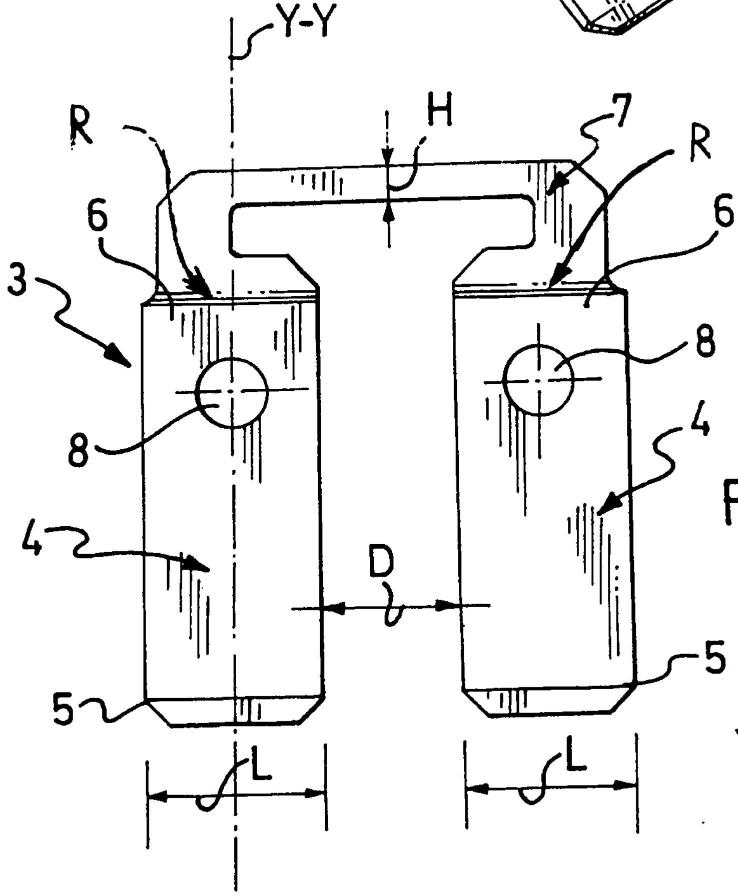

FIG.2

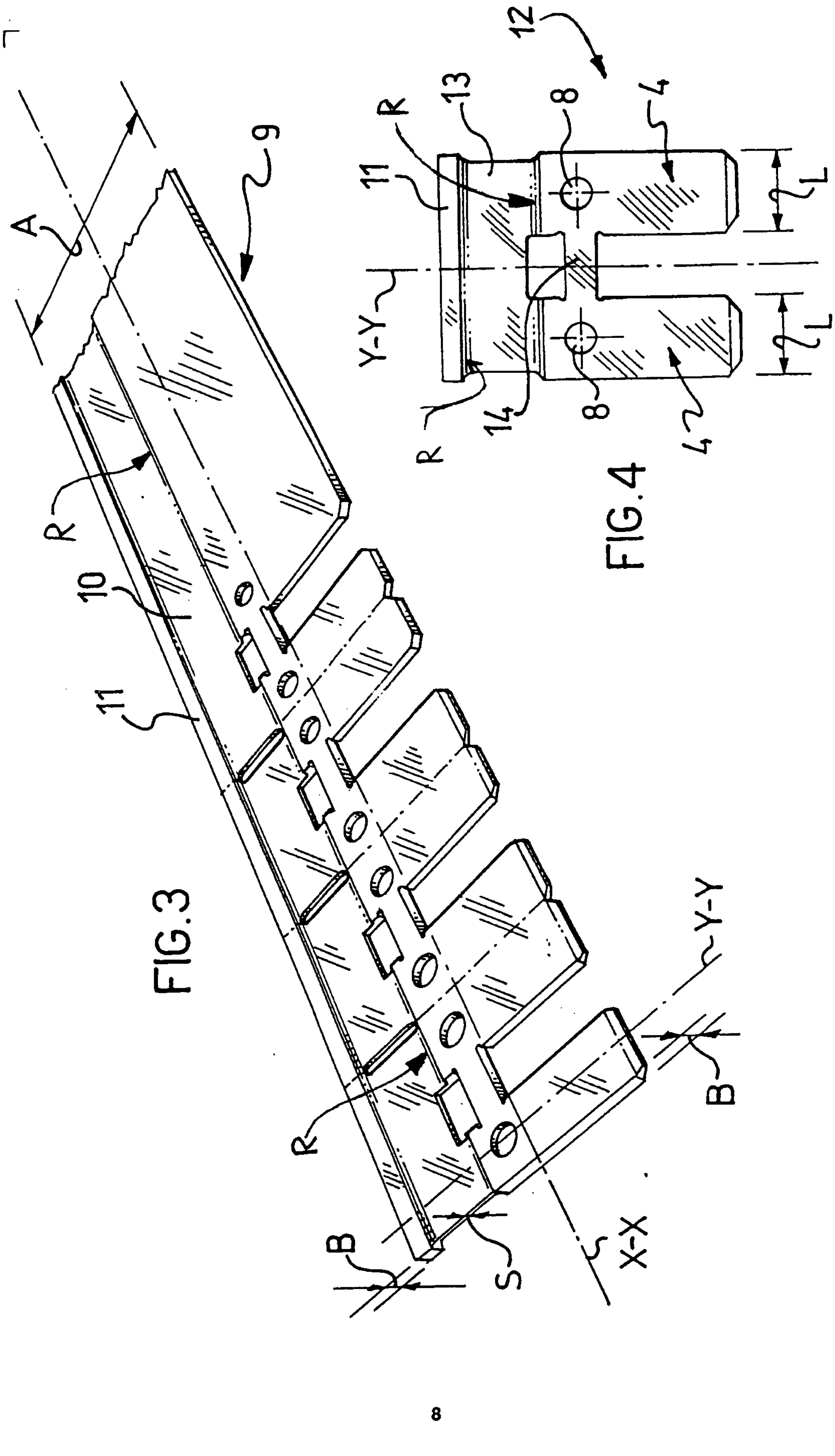

FIG.3

FIG.4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 83 0097

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	GB 2 113 489 A (PUDENZ KG WILHELM) 3 August 1983	1-3, 5-11,14	H01H85/041 H01H69/02
Y	* the whole document *	4,12	
Y	US 3 962 782 A (WILLIAMSON HAROLD L ET AL) 15 June 1976 * column 5, line 44 - line 68; figures *	4,12	
X	DE 27 14 797 A (KROMBERG & SCHUBERT) 22 February 1979 * the whole document *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 July 1998	Desmet, W

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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